SECTION 16215

METERING

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LANL MASTER CONSTRUCTION SPECIFICATION

When editing to suit Project, author shall add job-specific requirements and delete only those portions that do not apply to the Project (e.g., a component that does not apply). To seek a variance from applicable requirements, contact the Engineering Standards Manual (ESM) Electrical POC. Refer to http://www.lanl.gov/f6stds/pubf6stds/engrman/HTML/poc_techcom1.htm for the Engineering Standards Manual Personnel Link Index.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Delete information within “stars” during editing.

Specification developed for ML-3 / ML-4 projects. For ML-1 / ML-2, additional requirements and QA reviews are required.

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PART 1 GENERAL

1.1 SECTION INCLUDES

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Edit list match project requirements.

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A. Single-phase watt-hour meter

B. Multi-function, polyphase digital electrical meter.

C. Test switches.

D. Instrument transformers.

E. Meter cabinet.

F. Applications software.

1.2 LANL PERFORMED WORK

A. None

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01330, Submittal Procedures:

1. Catalog data and manufacturer's technical data, including data proving that materials comply with specified requirements. Provide catalog sheets showing ratings, dimensions, and enclosure details.

2. Installation instructions indicating application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

3. Test report for installed meter.

4. Wiring diagram showing connection requirements

5. Operation and maintenance instructions.

1.4 REGULATORY REQUIREMENTS

A. CONFORM TO REQUIREMENTS OF THE *National Electrical Code* (NEC).

B. Conform to requirements of ANSI C12.1 *American National Standard Code for Electricity Metering*.

C. Furnish products listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) as suitable for purposes specified and shown.

1.5 COORDINATION

A. Coordinate the features of the meter and associated current transformers and potential transformers with the ratings and characteristics of the circuit to be metered.

1.6 EXTRA MATERIALS

A. Furnish one spare for every five installed fuses, but not less than one set of three of each kind.

1.7 RECEIVING, STORING AND PROTECTING

A. Receive, store, and protect, and handle products according to NECA 1—*Standard Practices for Good Workmanship in Electrical Construction*.

PART 2 PRODUCTS

2.1 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to Section 01630, Product Options and Substitutions.

2.2 SINGLE-PHASE WATT-HOUR METER

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Use the meter specified in this article for 120/240 V single phase services up to 200 Amps. Delete article if there is no single-phase metering.

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A. Provide a self-contained, electro-mechanical watt-hour meter that meets the requirements of ANSI C12.10 *American National Standard for Electromechanical Watthour Meters* and has the following characteristics:

1. Form: 2S

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Use Class 100 for 100 A services and Class 200 for 200 A services.

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2. Class: [100] [200]

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Use 15 A test current for Class 100 meters and 30 A test current for Class 200 meters.

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3. Test current: [15] [30] amps

4. Voltage: 240 volts, single phase.

5. Wires: 3

6. Register: 5 dial clock type.

7. Cover: Polycarbonate

B. Manufacturer: ABB “Type AB1".

2.3 METER SOCKET

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Use the meter socket specified in this article for the single phase meter described in the previous article. Delete article if there is no single-phase meter.

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A. Provide ringless type meter socket for single phase watt-hour meter.

B. Provide socket to accommodate [overhead] [underground] service.

C. Socket shall be suitable for outdoor installation.

D. Socket shall be rated 200 amps, 600 volts.

E. Socket shall have an integral lever bypass and jaw release.

F. Socket shall be NRTL listed to UL 414 *Standard for Meter Sockets*.

G. Manufacturer: Square D “Class 4131”

2.4 MULTI-FUNCTION DIGITAL ELECTRICAL METER

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Use the meter specified in this article for three-phase services. Delete article if there is no three-phase metering.

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A. Provide an addressable microprocessor-based meter. Meter shall meet the following standards:

1. BE NRTL LISTED TO UL 508 *Standard for Safety Industrial Control Equipment*.

2. Meet requirements of ANSI C12.16, *American National Standard for Solid-State Electricity Meters*.

3. Meet NEMA C12.20, *Electricity Meters 0.2 and 0.5 Accuracy Classe,s* 0.5S class for energy revenue metering.

B. The meter shall sample current and voltage signals at a rate high enough to provide true-RMS metering accurate beyond the 50th harmonic.

C. The meter shall be rated for an operating temperature range of -25 degrees C to 70 degrees C and have a current input withstand rating of 300 amps for 1 second.

D. Setup parameters required for the meter shall be stored in non-volatile memory and retained in the event of a control power interruption. Any battery used to provide non-volatile memory must be serviceable from the front of the meter.

E. The meter shall display the following metered values on a faceplate alphanumeric readout and shall auto range between Units, Kilo-Units, and Mega-Units. The information shall be also available at a remote computer through a communications network:

1. Real-time readings (accuracy expressed as percent of reading):

a. Current: ±0.20 percent accuracy, true RMS
Phases A, B, C, 3-phase average
Neutral

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Edit specification to match project requirements. Delete if ground current measurement is not required.

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Ground (with separate current transformer)

b. Voltage: ±0.20 percent accuracy, true RMS
Phases A-B, B-C, C-A
3-phase average line-to-line
Phases A-N, B-N, C-N
3-phase average line-to-neutral

c. Power: ±0.40 percent accuracy, true RMS
Real (watts)
Reactive (vars)
Apparent (VA)
Phases A, B, C, 3-phase total

d. Frequency: ±0.04 percent accuracy

e. Power Factor: ±0.80 percent accuracy
Displacement
Apparent
Phases A, B, C, 3-phase total

f. % THD - Current: ±1.00 percent accuracy
Phases A, B, C, Neutral

g. % THD - Voltage: ±1.00% accuracy
Phases A-B, B-C, C-A
Phases A-N, B-N, C-N

h. K-Factor - Current: ±1.00% accuracy
Phases A, B, C, 3-phase total

2. Energy Readings (accuracy expressed as percent of reading):

a. Real (kWh): ±0.4% accuracy
Phases A, B, C, 3-phase total
Forward, reverse, net

b. Reactive (kvarh): ±0.4% accuracy
Phases A, B, C, 3-phase total
Forward, reverse, net

c. Apparent (kVAh): ±0.4% accuracy
Phases A, B, C, 3-phase total

3. Demand readings (accuracy expressed as percent of reading):

a. Current (amperes): ±0.4% accuracy
3-phase average
Last completed interval, peak

b. Real power (kW): ±0.4% accuracy
3-phase total
Last completed interval, peak

c. Reactive power (kvar): ±0.4% accuracy
3-phase total
Last completed interval, peak

d. Apparent power (kVA): ±0.4% accuracy
3-phase total
Last completed interval, peak

F. Meter shall be capable of power demand calculations using either of the following user-selectable methods:

1. Thermal demand using a sliding window updated every 15 seconds with window length field selectable from 5 to 60 minutes in 5 minute increments.

2. Block interval with or without sub-intervals. Window length field selectable from 5 to 60 minutes in 5 minute increments. Sub-interval length field selectable from 5 to 60 minutes in 5 minute increments.

G. The meter shall provide waveform captures of steady state voltage and current waveforms that can be transmitted to a remote PC for display and analysis using appropriate software.

1. The meter shall be capable of storing in non-volatile memory up to 30 cycles of each phase voltage and current sampled at a rate of 128 samples per cycle.

2. Meter shall initiate waveform capture either on manual command from a remote PC or by self-triggering due to an over/under condition.

H. The meter shall maintain a user selectable combination of trend and event logging information in non-volatile memory. The information shall be available for local downloading or available at a remote computer through a communications network. Minimum trend and logging capabilities shall be as follows:

1. 4 trend log files each capable of logging 24 parameters.

2. User selectable sampling rate for each log file

3. Internal storage capacity of 89000 date and time stamped logged data points.

4. Logging triggered by user-defined event or new maximum or minimum of metered value.

5. Minimum and maximum of each measured parameter date and time stamped.

6. Alarm and event log of 500 events.

I. The meter shall accept inputs from industry standard instrument transformers.

1. The meter shall allow potential connection to circuits up to 600 volts AC without the use of external potential transformers. External potential transformer ratios up to 500,000:120 VAC shall be supported.

2. Current transformer ratios up to 10,000:5 A shall be supported.

J. The meter shall operate properly with control power input from 110 to 240 VAC, 45 – 66 Hz.

K. The meter shall be equipped with the following digital communications ports.

1. A rear mounted RS-485 port that is capable of communicating over a twisted pair network using Modbus or Jbus protocol.

2. A rear mounted RJ-45 Ethernet port that is capable of at least 10 Base T communications to TCP/IP-based networks using embedded HTML pages.

L. Meter shall provide KYZ output pulses that can be user-programmed for kWH, kVARH or kVAH. The value of a pulse shall be programmable, allowing control of the maximum pulse rate to meet the requirements of the receiving equipment.

M. Provide operator interface with high visibility alpha-numeric display to show metering data, min/max values, alarms, and inputs.

N. Manufacturer: Square D “CM3250 meter with CMDVF display and ECC21 communications module”, Eaton Cutler-Hammer IQ6400 meter and WEBPONI communications module”

2.5 INSTRUMENT TRANSFORMERS

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Edit article to match Project requirements. Adequate instrument transformers may exist in retrofit applications. Instrument transformers are not used with the specified single-phase meter. Delete this article if not needed.

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A. Provide current transformers and potential transformers, conforming to NEMA EI 21.1 and ANSI C57.13, metering accuracy class 0.3, of suitable ratio and burden for specified metering.

B. Provide current transformers having 5 Amp secondaries and a continuous current rating factor of not less than 1.33.

1. Provide two current transformers for 3-phase, 3-wire delta circuits. Select current transformer primary to match circuit overcurrent device trip rating.

2. Provide three current transformers for 3-phase, 4-wire wye circuits. Select current transformer primary to match circuit overcurrent device trip rating.

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Edit 3 to match Project requirements. Provide neutral current transformers where substantial neutral current is anticipated due to the nature of the electrical load. Most facilities (e.g. office buildings, warehouses, etc.) do not have substantial neutral current. Delete article if not needed.

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3. Provide a neutral current transformer for low voltage 3-phase, 4-wire wye circuits. Select current transformer primary to match circuit overcurrent device trip rating.

4. Current transformers for low voltage circuits (600 V and less) shall have 10 kV BIL. Current transformers for 13.8 kV circuits shall have 110 kV BIL.

5. Provide with window opening adequate for the conductors or bus bars.

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Edit 6 to match Project requirements. Select CT to match system voltage and current.

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6. Manufacturer: ABB

a. Type CMS, through 200:5 at 600 V or less.

b. Type CMF, through 1200:5 at 600 V or less.

c. Type CMV, through 3000:5 at 600 V or less.

d. Type CLC, through 4000:5 at 600 V or less.

e. Type CLE, through 5000:5 at 600 V or less.

f. Type KIR-11, indoors at 13.8 kV.

g. Type KOR-11, outdoors at 13.8 kV.

h. Type KON-11, outdoors at 13.8 kV.

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Edit C to match Project requirements. The meters in 2.1 and 2.2 will not require potential transformers connected to 480Y/277 V system.

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C. Provide potential transformers having 120 VAC secondaries.

1. Provide two potential transformers for 3-phase, 3-wire delta circuits. Select potential transformer primary to match system line-to-line voltage.

2. Provide three potential transformers for 3-phase, 4-wire wye circuits. Select potential transformer primary to match system line-to-line voltage.

3. Potential transformers for low voltage circuits (600 V and less) shall have 10 kV BIL. Potential transformers for 13.8 kV circuits shall have 110 kV BIL.

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Edit 4 to match Project requirements. Select PT to match system voltage.

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4. Manufacturer: ABB

a. Type VIZ-11 with 2 primary fuses for 13.8 kV system indoors.

b. Type VOY-11 for 13.8 kV system outdoors.

c. Type PPW for 480 V system.

2.6 TEST SWITCHES AND PLUGS

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Edit article to match Project requirements. Adequate test switches and plugs may exist in retrofit applications. Test switches and plugs are not required with the specified single-phase meter. Delete this article if not needed.

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A. Provide semi-flush mounted test switches in meter potential and current circuits to facilitate testing of the meter installation and also external connection of additional portable metering equipment.

B. Provide test switches that comply with ANSI C12.9 and automatically short circuit current transformer circuits when the switches are opened preparatory to inserting the test plug.

C. Test switch shall have potential and shorting type current poles as follows:

1. 3 wire delta systems: 3 potential poles and 4 shorting type current poles.

2. 4 wire wye systems: 4 potential poles and 6 shorting type current poles.

3. 4 wire wye systems with metered neutral: 4 potential poles and 8 shorting type current poles.

D. Provide matching test plugs designed for in-service testing.

E. Manufacturers: States “Type FMS”.

2.7 POTENTIAL CIRCUIT FUSES

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Edit article to match Project requirements. Delete if there is no three-phase metering.

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A. Provide UL Class CC, fast-acting, 600 V fuses to protect each potential lead to the meter and to protect the primary of each 480:120 VAC potential transformer.

1. Provide 1 Amp fuses to protect each potential lead to the meter.

2. Provide 2 Amp fuses to protect the primary of each 480:120 VAC potential transformer.

3. Provide each fuse with a cover having a blown-fuse indicator.

4. Manufacturer: Bussman “Type KTK-R fuses, Class CC fuseblocks, and SAMI fuse covers.”

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Edit article to match Project requirements. Delete on low-voltage systems.

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B. For indoor medium-voltage metering installations, protect the primary of each potential transformer with indoor, current-limiting, 1/2 Amp, 14,400 V fuses having blown fuse indication. Manufacturer: S&C “Fusistor.”

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Edit article to match Project requirements. Delete on low-voltage systems.

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C. For outdoor medium-voltage metering installations, protect the primary of each potential transformer with outdoor, 1 Amp, 14,400 V power fuses. Manufacturer: S&C “SMD-20 with SMU-20 fuse unit”.

2.8 WIRING AND TERMINATIONS

A. Use No. 12 AWG, Type THHN-THWN stranded copper, for current transformer secondary circuits that are less than 50 ft. Use No. 10 AWG, Type THHN-THWN stranded copper, for current transformer secondary circuits that are more than 50 ft.

B. Use No. 12 AWG, Type THHN-THWN, stranded copper, for potential transformer secondary circuits.

C. Use crimp-on, nylon insulated, insulation grip, brazed seam terminals for instrument wiring as follows:

1. Use ring tongue terminals for nutted studs. Manufacturer: Burndy “Type TN”

2. Use flanged fork terminals for barrier terminal strips. Manufacturer: Burndy “type YAE-Z”.

3. Use pin terminals for DIN type terminal blocks. Manufacturer: 3M type “MNG-P”.

2.9 METER CABINET

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Edit article to match Project requirements. Use meter cabinet for retrofit applications or where there is insufficient space to mount the meter and test switches in the switchgear. Approximate size of cabinet required is 24" X 20" x 10", but this should be verified. Meter cabinet is not needed for single-phase meter. If current transformers or potential transformers can’t be installed in the switchgear or panelboard, include space for current transformers in the meter cabinet. Delete article if not needed.

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A. Provide a metal cabinet with hinged door to house the meter, test switches, fuse blocks, [current transformers,] [potential transformers,] and terminal strips.

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Edit B to match project requirements.

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B. [Provide a NEMA 3R cabinet for outdoor installation.] [Provide a NEMA 12 cabinet for non-hazardous indoor installation.]

C. Provide a swing-out panel mounted behind the cabinet door for mounting the meter and test switches.

D. Provide ground lug mounted to the inside of the cabinet and flexible ground straps for bonding the swing-out panel to the cabinet.

E. Manufacturer: Hoffman

2.10 APPLICATIONS SOFTWARE

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Edit article to match project requirements. Applications software not required for single-phase metering. If the Facility Manager already has suitable applications software, another copy is not needed. Delete this article if not needed.

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A. Provide application software to download and display metered data, recorded events, and captured waveforms on a PC through a TCP/IP-based network.

B. Application software shall operate on a PC with a Microsoft Windows NT or Windows 2000 operating system.

C. Software shall provide multiple levels of password protection to protect data and setup.

D. Software shall provide a help system that is con-line and context sensitive.

E. Software shall provide the following capabilities when connected to a meter with the corresponding data collection capabilities:

1. Display real-time graphical analog meters.
2. Display real-time bar charts.
3. Provide tabular display of instantaneous data.
4. Display voltage and current waveform captures.
5. Record and display events and alarms with date/time and description.
6. Analyze and display data in multiple report tabular and graphic formats.
7. Perform data trending and display historical trend plots.
8. Export historical data to other file types.
9. Output data logging to printer.
10. Calculate and display residual current.
11. Export captured waveforms for harmonic analysis.

F. By entering appropriate passwords, operator shall be able to configure the addressable microprocessor-based meter through the applications software.

G. Manufacturer: Square D “POWERLOGIC SMS-121.” Cutler-Hammer: “PowerNet”

PART 3 EXECUTION

3.1 EXISTING WORK

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Delete this article when existing construction is not affected.
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A. Remove abandoned meters, including associated cabinets, instrument transformers and test blocks.

B. Maintain access to existing meters and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing meters and associated cabinets, instrument transformers and test blocks to remain or to be reinstalled.

3.2 EXAMINATION

A. Examine surfaces to receive meters and associated cabinets, instrument transformers and test blocks for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Install metering equipment where indicated on the Drawings and according to manufacturer's instructions. Have the manufacturer's installation instructions available at the construction site.

B. Mount meter readout approximately 60 inches above the floor. Install meter and enclosure plumb.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not furnished, use those specified in UL 486A.

D. Provide control power to meter from a dedicated reliable 120 volt circuit.

E. Wire current and potential leads through test switch. Use shorting switches for the current transformer leads.

F. Follow manufacturer's instructions to setup meter to match electrical system and instrument transformer characteristics. Set demand calculation method to 15 minute sliding window thermal demand.

G. Install metering software on the building automation system PC or other PC designated by the Contract Administrator. Set up software and assign passwords as directed by the LANL Utilities Group.

H. Provide telecommunications outlet within 4 ft of meter. Connect meter to telecommunications outlet and set up communications over the LANL network.

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Edit I, J, and K to match the current LANL standard specification numbers. Specifications are being updated in phases during 2003. The first section listed is the current number; the second is the intended future number.

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Edit I to match project requirements.

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I. IDENTIFY METER, [TEST SWITCHES,] [INSTRUMENT TRANSFORMERS,] AND METER WIRING ACCORDING TO [SECTION 16195—ELECTRICAL IDENTIFICATION] [SECTION 16075—ELECTRICAL IDENTIFICATION].

J. Ground meter and enclosure according to manufacturer's instructions and requirements in [Section 16450—SECONDARY GROUNDING] [Section 16060—GROUNDING AND BONDING].

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Edit K to match project requirements.

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K. Support meter, [meter base,] [meter cabinet,] [instrument transformers] in accordance with the requirements of [Section 16190—ELECTRICAL SUPPORTING DEVICES] [Section 16070—HANGERS AND SUPPORTS] and the NEC.

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Edit L to match project requirements.

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L. Deliver applications software to [Contract Administrator] [Project Leader] [Facility Manager].

3.4 FIELD QUALITY CONTROL

A. Inspect accessible components for cleanliness, mechanical, and electrical integrity, and for presence of damage or deterioration before energizing.

B. Verify that meter type, scale, and connection are in accordance with the Drawings, Specifications and manufacturer's instructions.

C. Verify proper fuses are installed for meter potential circuits.

D. Using separate calibrated meters, verify correct connection, setup, and functioning of each meter function. Submit test report.

E. Verify that meter communicates properly with the designated PC over the LANL communications network.

F. After completing installation, cleaning, and testing, touch up scratches and mars on finish to match original finish.

END OF SECTION

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Do not delete the following reference information.

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FOR LANL USE ONLY

This project specification is based on LANL Master Construction Specification Rev. 1, dated December 1, 2003.